IN625

ASTM F3056 / ASTM B446 / AMS5666

MATERIAL DATA SHEET

Nikon SLM SOLUTIONS

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MATERIAL

Nickel-based superalloys have been specifically designed to withstand extreme conditions in which other materials already fail. IN625 is a heat-resistant Ni-Cr-Mo-alloy with high tensile and creep strength, combined with an excellent corrosion and oxidation resistance against sea water or chemicals. It is primarily used in gas turbines, but also in motorsports or ship building.

CHEMICAL COMPOSITION

ASTM F3056 / ASTM B446 / AMS5666[1]													
	Ni	**Cr**	**Mo**	**Fe**	**Nb+Ta**	**Co**	**Mn**	**Si**	**Al**	**Ti**	**C**	**P**	**S**
Min.	Bal.	20.00	8.00		3.15								
Max.		23.00	10.00	5.00	4.15	1.00	0.50	0.50	0.40	0.40	0.10	0.015	0.015

POWDER PROPERTIES

Particle Size[1]	10 -45 µm
Mass Density[2]	≈ 8.44 g/cm³
Particle Shape[3]	Spherical

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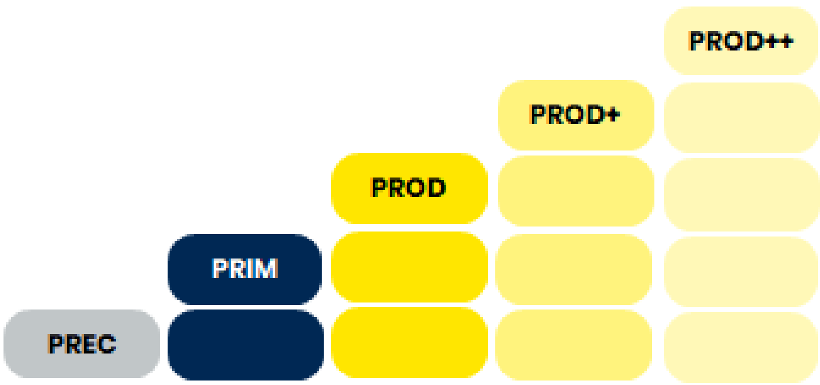
NIKON SLM® PARAMETERS

It only takes 3 tools to make you successful with metal additive manufacturing:

1. The **NIKON SLM® machine** fitting your needs,
2. The **metal powder** that defines the later purpose and functionality of a part,
3. Precisely engineered **NIKON SLM® parameters** as the missing link.

Our open parameters are the result of our vast experience in multi-laser technology and a diligent development and qualification procedure. They are key to produce fully functional parts with properties you can expect and rely on – whether you are new to AM or a large-scale production operator. We offer them to you in the following categories: **Precision (PREC)** for high-resolution complex details, **Prime (PRIM)** for balanced properties with improved productivity and **Productivity (PROD)** for the highest build rates. Pushing boundaries is in our work culture, we can also offer a new dimension of productivity on selected materials with **Productivity+ (PROD+)** and **Productivity++ (PROD++)** parameters.



MATERIAL QUALIFICATION

As one of the inventors of the selective laser melting process, we impose the most comprehensive test procedures on ourselves: hundreds of samples, multiple systems, various powder batches, numerous heat-treatments, machined vs. near-net-shape tensile specimens, several surface roughness conditions and angles, fatigue behavior, corrosion investigation, creep testing... Did we miss anything? Get in touch with us!

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SLM®280 PRECISION

Parameter Set	IN625_SLM280_PREC_MBP3_V1 (30 µm)
Machine Compatibility	SLM®280 2.0, SLM®280 Production System (400W)
Validated Data Preparation	Materialise SLM Build Processor
Theoretical System Build Rate[4]	28.1 cm³/h (Twin)
Minimum Relative Density[5,7]	99.8 %

MECHANICAL PROPERTIES[6]

M: Mean | MIN: Minimum (95 % population coverage / 95 % confidence level)[7]

Non-heat-treated

	Tensile strength R_m [MPa]		Yield strength $R_{p0.2}$ [MPa]		Elongation at break A [%]	
Machined	**M**	**MIN**	**M**	**MIN**	**M**	**MIN**
Horizontal	1030	980	750	710	33	30
Vertical	950	900	670	640	38	34
Near-Net-Shape	**M**	**MIN**	**M**	**MIN**	**M**	**MIN**
Vertical	925	870	650	625	41	36

Heat-treated (ANN1)[8]

	Tensile strength R_m [MPa]		Yield strength $R_{p0.2}$ [MPa]		Elongation at break A [%]	
Machined	**M**	**MIN**	**M**	**MIN**	**M**	**MIN**
Horizontal	1010	960	680	640	34	31
Vertical	950	900	650	620	38	34

Heat-treated (ANN2)[9]

	Tensile strength R_m [MPa]		Yield strength $R_{p0.2}$ [MPa]		Elongation at break A [%]	
Machined	**M**	**MIN**	**M**	**MIN**	**M**	**MIN**
Horizontal	960	910	580	480	40	36
Vertical	890	850	560	500	44	40

HARDNESS[10]

M: Mean | MIN: Minimum (95 % population coverage / 95 % confidence level)[7]

	Vickers hardness HV10	
	M	**MIN**
As built	300	280
ANN1[8]	290	270
ANN2[9]	255	235

SURFACE ROUGHNESS[11]

M: Mean | MAX: Maximum (95 % population coverage / 95 % confidence level)[7]

	Roughness average Ra [µm]		Mean roughness depth Rz [µm]	
	M	**MAX**	**M**	**MAX**
As built	6	12	40	70

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SLM®280 PRIME

Parameter Set	IN625_SLM280_PRIM_MBP3_V1 (60 µm)
Machine Compatibility	SLM®280 2.0, SLM®280 Production System (400 W)
Validated Data Preparation	Materialise SLM Build Processor
Theoretical System Build Rate[4]	52.4 cm³/h (Twin)
Minimum Relative Density[5,7]	99.8 %

MECHANICAL PROPERTIES[6]

M: Mean | MIN: Minimum (95 % population coverage / 95 % confidence level)[7]

Non-heat-treated

	Tensile strength R_m [MPa]		Yield strength $R_{p0.2}$ [MPa]		Elongation at break A [%]	
Machined	**M**	**MIN**	**M**	**MIN**	**M**	**MIN**
Horizontal	985	930	690	650	36	32
Vertical	905	850	620	590	42	36
Near-Net-Shape	**M**	**MIN**	**M**	**MIN**	**M**	**MIN**
Vertical	875	825	605	570	43	38

Heat-treated (ANN1)[8]

	Tensile strength R_m [MPa]		Yield strength $R_{p0.2}$ [MPa]		Elongation at break A [%]	
Machined	**M**	**MIN**	**M**	**MIN**	**M**	**MIN**
Horizontal	985	930	630	590	38	32
Vertical	900	850	610	570	44	35

Heat-treated (ANN2)[9]

	Tensile strength R_m [MPa]		Yield strength $R_{p0.2}$ [MPa]		Elongation at break A [%]	
Machined	**M**	**MIN**	**M**	**MIN**	**M**	**MIN**
Horizontal	910	880	545	440	40	36
Vertical	860	830	500	415	52	42

HARDNESS[10]

M: Mean | MIN: Minimum (95 % population coverage / 95 % confidence level)[7]

	Vickers hardness HV10	
	M	**MIN**
As built	285	270
ANN1[8]	270	245
ANN2[9]	235	205

SURFACE ROUGHNESS[11]

M: Mean | MAX: Maximum (95 % population coverage / 95 % confidence level)[7]

	Roughness average Ra [µm]		Mean roughness depth Rz [µm]	
	M	**MAX**	**M**	**MAX**
As built	8	13	48	71

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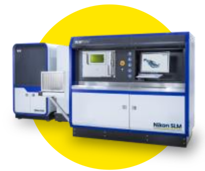

SLM®500 PRECISION

Parameter Set	IN625_SLM500_PREC_MBP3_V1 (30 µm)
Machine Compatibility	SLM®500 (400 W)
Validated Data Preparation	Materialise SLM Build Processor
Theoretical System Build Rate[4]	56.2 cm³/h (Quad)
Minimum Relative Density[5,7]	99.8 %

MECHANICAL PROPERTIES[6]

M: Mean | MIN: Minimum (95 % population coverage / 95 % confidence level)[7]

Non-heat-treated

	Tensile strength R_m [MPa]		Yield strength $R_{p0.2}$ [MPa]		Elongation at break A [%]	
Machined	M	MIN	M	MIN	M	MIN
Horizontal	1030	980	750	710	33	30
Vertical	950	900	670	640	38	34
Near-Net-Shape	M	MIN	M	MIN	M	MIN
Vertical	925	870	650	625	41	36

Heat-treated (ANN1)[8]

	Tensile strength R_m [MPa]		Yield strength $R_{p0.2}$ [MPa]		Elongation at break A [%]	
Machined	M	MIN	M	MIN	M	MIN
Horizontal	1010	960	680	640	34	31
Vertical	950	900	650	620	38	34

Heat-treated (ANN2)[9]

	Tensile strength R_m [MPa]		Yield strength $R_{p0.2}$ [MPa]		Elongation at break A [%]	
Machined	M	MIN	M	MIN	M	MIN
Horizontal	960	910	580	480	40	36
Vertical	890	850	560	500	44	40

HARDNESS[10]

M: Mean | MIN: Minimum (95 % population coverage / 95 % confidence level)[7]

	Vickers hardness HV10	
	M	MIN
As built	300	280
ANN1[8]	290	270
ANN2[9]	255	235

SURFACE ROUGHNESS[11]

M: Mean | MAX: Maximum (95 % population coverage / 95 % confidence level)[7]

	Roughness average Ra [µm]		Mean roughness depth Rz [µm]	
	M	MAX	M	MAX
As built	6	12	40	70

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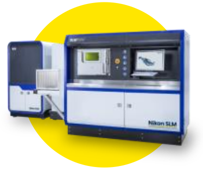

SLM®500 PRIME

Parameter Set	IN625_SLM500_PRIM_MBP3_V1 (60 µm)
Machine Compatibility	SLM®500 (400 W)
Validated Data Preparation	Materialise SLM Build Processor
Theoretical System Build Rate[4]	104.8 cm³/h (Quad)
Minimum Relative Density[5,7]	99.8 %

MECHANICAL PROPERTIES[6]

M: Mean | MIN: Minimum (95 % population coverage / 95 % confidence level)[7]

Non-heat-treated

	Tensile strength R_m [MPa]		Yield strength $R_{p0.2}$ [MPa]		Elongation at break A [%]	
Machined	M	MIN	M	MIN	M	MIN
Horizontal	980	930	680	650	35	32
Vertical	905	850	620	590	42	36
Near-Net-Shape	M	MIN	M	MIN	M	MIN
Vertical	875	825	595	570	42	38

Heat-treated (ANN1)[8]

	Tensile strength R_m [MPa]		Yield strength $R_{p0.2}$ [MPa]		Elongation at break A [%]	
Machined	M	MIN	M	MIN	M	MIN
Horizontal	980	930	630	590	35	32
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Heat-treated (ANN2)[9]

	Tensile strength R_m [MPa]		Yield strength $R_{p0.2}$ [MPa]		Elongation at break A [%]	
Machined	M	MIN	M	MIN	M	MIN
Horizontal	920	880	540	440	40	36
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HARDNESS[10]

M: Mean | MIN: Minimum (95 % population coverage / 95 % confidence level)[7]

	Vickers hardness HV10	
	M	MIN
As built	285	270
ANN1[8]	265	245
ANN2[9]	235	205

SURFACE ROUGHNESS[11]

M: Mean | MAX: Maximum (95 % population coverage / 95 % confidence level)[7]

	Roughness average Ra [µm]		Mean roughness depth Rz [µm]	
	M	MAX	M	MAX
As built	8	13	48	71

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DISCLAIMER

The properties and mechanical characteristics apply to powder that is tested and sold by Nikon SLM Solutions, and that has been processed on Nikon SLM Solutions machines using the original Nikon SLM Solutions parameters in compliance with the applicable operating instructions (including installation conditions and maintenance). The part properties are determined based on specified procedures. More details about the procedures used by Nikon SLM Solutions are available upon request.

The specifications correspond to the most recent knowledge and experience available to us at the time of publication and do not form a sufficient basis for component design on their own. Certain properties of products or parts or the suitability of products or parts for specific applications are not guaranteed. The manufacturer of the products or parts is responsible for the qualified verification of the properties and their suitability for specific applications. The manufacturer of the products or parts is responsible for protecting any third-party proprietary rights as well as existing laws and regulations.

MDS_IN625_2024-04.1_EN

CONTACT

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NOTES

[1] With respect to powder material. Compositions stated as mass or weight percent.

[2] Material density varies within the range of possible chemical composition variations.

[3] According to DIN EN ISO 3252:2023.

[4] Theoretical system build rate = layer thickness x scan speed x hatch distance x number of lasers. The value represents a com-parable indicator but remains a theoretical value after all. It does expressively not reflect true build rates, which are influenced by part geometry, ratio between hatch and contour areas, area of exposure, recoating times, and more.

[5] Optical density determination at test specimens by light microscopy according to internal specification. Relative density may vary depending on part geometry, orientation, volume, and other process factors. Population coverage: 99%, confidence level: 99%.

[6] Tensile testing was performed in accordance to DIN EN ISO 6892-1:2020 B and conducted at room temperature. Samples are either machined before testing or tested in near-net-shape without any surface finishing (geometry according to DIN 50125:2016-D6x30). Samples labelled "Horizontal" correspond to a polar angle of θ = 90°; samples labelled "vertical" correspond to a polar angle of θ = 0° (DIN EN ISO/ASTM 52921). Values include overlap samples, i.e. multiple lasers work simultaneously on one specimen. All data is derived from standardized SLM Solutions qualification jobs. Samples are built out of both virgin powder as well as used powder. Population coverage: 95%, confidence level: 95%.

[7] Minimum or maximum values are set by using tolerance interval method, which is a statistical approach based on the input of population coverage (PC) and confidence level (CL). Tolerance intervals ensure that a certain percentage of samples within a batch will be above the minimum value or below the maximum value with a certain probability, e.g. the probability that 95% of all samples will be above the minimum value or below the maximum value (within a defined batch and tested according to mentioned specifications) is 95%.

[8] Annealing was made at 870 °C (1600 °F) +/-14 °C (25 °F) in vacuum for one hour with inert gas quench in nitrogen, at a rate equivalent to or faster than air cooling, acc. to AMS 5599. For guidance on soaking times, the holding time is commensurate to the section thickness acc. to AMS 5599.

[9] Annealing was made at 1038 °C (1900 °F) +/-14 °C (25 °F) in vacuum for one hour with inert gas quench in nitrogen at a rate equivalent to or faster than air cooling, acc. to AMS 2774 and ASTM F3056-14 Class B. For guidance on soaking times, the holding time is commensurate to the section thickness acc. to AMS 2774.

[10] Hardness testing according to DIN EN ISO 6507-1:2024. Measurement direction “2” according to VDI 3405 2.1. Values include overlap samples, i.e. multiple lasers work simultaneously on one specimen. All data is derived from standardized SLM Solutions qualification jobs. Samples are built out of both virgin powder as well as used powder.

[11] Roughness measurement on vertical walls according to DIN EN ISO 21920-3:2022; $\lambda c = 2.5$ mm. Glass bead blasting is an additional post-processing step after corundum blasting. Values include overlap samples, i.e. multiple lasers work simultaneously on one specimen. All data is derived from standardized SLM Solutions qualification jobs. Samples are built out of both virgin powder as well as used powder.